Regional Operational Plan SF.2A.2013.05

Anchor River Chinook Salmon Stock Assessment, 2013

by

Carol M. Kerkvliet

and

Michael D. Booz

May 2013

Alaska Department of Fish and Game **Divisions of Sport Fish and Commercial Fisheries**

Symbols and Abbreviations

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Weights and measures (metric)	
centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
milliliter	mL
millimeter	mm
Weights and measures (English)	
cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
nautical mile	nmi
ounce	oz
pound	lb
quart	qt
yard	yd
Time and temperature	
day	d
degrees Celsius	°C
degrees Fahrenheit	°F
degrees kelvin	K
hour	h
minute	min
second	s
Physics and chemistry	
all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity (negative log of)	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General	
Alaska Administrative Code	AAC
all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.
all commonly accepted professional titles	e.g., Dr., Ph.D., R.N., etc.
at	@
compass directions:	
east	E
north	N
south	S
west	W
copyright	©
corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
District of Columbia	D.C.
et alii (and others)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.
Federal Information Code	FIC
id est (that is)	i.e.
latitude or longitude	lat. or long.
monetary symbols (U.S.)	$, ¢
months (tables and figures): first three letters	Jan,...,Dec
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S.C.	United States Code
U.S. state	use two-letter abbreviations (e.g., AK, WA)

Mathematics, statistics	
all standard mathematical signs, symbols and abbreviations	
alternate hypothesis	H_A
base of natural logarithm	*e*
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	(F, t, χ^2, etc.)
confidence interval	CI
correlation coefficient (multiple)	R
correlation coefficient (simple)	r
covariance	cov
degree (angular)	°
degrees of freedom	df
expected value	*E*
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	log_2, etc.
minute (angular)	'
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
variance	
population	Var
sample	var

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By
Carol M. Kerkvliet
Alaska Department of Fish and Game, Division of Sport Fish, Homer
and
Michael D. Booz
Alaska Department of Fish and Game, Division of Sport Fish, Homer

Alaska Department of Fish and Game
Division

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Carol Kerkvliet and Michael D. Booz

Alaska Department of Fish and Game, Division of Sport Fish,
3298 Douglas Place, Homer, AK 99603-7942, USA

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SIGNATURE PAGE

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Title	Name	Signature	Date
Project leader	Carol Kerkvliet		5/1/13
Biometrician	David Evans		4/26/13
Research Coordinator	Jack Erickson		5/2/2013

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BACKGROUND

The Anchor River is located on the southern portion of the Kenai Peninsula (Figure 1) and supports the largest fresh water sport fishery in the Lower Cook Inlet (LCI) Management Area. The Anchor River watershed is approximately 587 km^2, with about 266-river km (rkm) of anadromous streams. There are two major forks of the Anchor River, the South Fork and North Fork, with the South Fork watershed being approximately twice the size of the North Fork. Primary species targeted in the sport fisheries are Chinook salmon *Oncorhynchus tshawytscha*, coho salmon *O. kisutch* salmon and steelhead trout *O. mykiss*. This operational plan describes assessment of the Chinook salmon population in the Anchor River.

The major Chinook salmon stocks in the LCI area are found in the Ninilchik River, Deep Creek and Anchor River, with the Anchor River stock being the largest (Szarzi et al 2010). The Anchor River supports the largest freshwater harvest of wild Chinook salmon within the LCI area. The run timing of Chinook salmon in LCI streams is approximately early May through late July with a peak in early June. Anchor River Chinook salmon spend one year rearing in fresh water before they smolt, and spend 1 to 4 years feeding in the salt water before they return to spawn.

The Anchor River Chinook salmon escapement project was initiated in 2003 and used a **D**ual frequency **ID**entification **SON**ar (DIDSON) in May and June at a site approximately 2.8 rkm (approximately 2 mile) from the mouth. From 2004 to 2008 and from 2010, Chinook salmon escapement was monitored using a DIDSON during high discharge rates in the early spring and then via a resistance board weir once river levels subside. In 2009, the DIDSON was not required because low water levels allowed for the immediate installation of the resistance board weir, which provided the first Chinook salmon escapement census for the Anchor River (Kerkvliet et al 2008, Kerkvliet and Burwen 2010, Kerkvliet et al In prep, Kerkvliet and Booz 2011). Historical escapement estimates are given in Table 1.

Table 1 Anchor River Chinook salmon escapement estimates, 2003-2011

Year	Method	Estimate	SE
2003	DIDSON	9,238	Census
2004	DIDSON/Weir	12,016	849
2005	DIDSON/Weir	11,156	229
2006	DIDSON/Weir	8,945	289
2007	DIDSON/Weir	9,622	238
2008	DIDSON/Weir	5,806	169
2009	Weir	3,455	Census
2010	DIDSON/Weir	4,437	103
2011	DIDSON/Weir	3,547	Census

The results of the Anchor River Chinook salmon escapement project have had significant bearing on fishery regulations. The 2003 Chinook salmon escapement was much higher and the estimated exploitation rate much lower (<11%) than previously suggested from historic aerial index counts (Szarzi et al. 2007). In 2004, the Division of Sport Fish (DSF) issued an emergency order (EO) that added a 5th weekend of fishing for Chinook salmon because 10,500 Chinook salmon had been estimated as of June 21 of that year, exploitation was expected to be low, and additional harvest was gauged to be sustainable with the current escapement. In the fall of 2004, significant changes were made to the Chinook salmon sport fishery: the Board of Fisheries (BOF) rescinded the stock of management concern listing, the BOF liberalized the Chinook salmon sport fishery by adding a 5th opening weekend before Memorial Day, and the DSF rescinded the SEG based on aerial indices. In the fall of 2007, the department established a lower bound SEG threshold of 5,000 Chinook salmon, and the Board cautiously liberalized the fresh and marine sport fisheries to increase exploitation on Anchor River Chinook salmon. The 2008 escapement exceeded the SEG threshold by 806 fish. Over the next four years escapement declined (3,455 in 2009, 4,437 in 2010, and 3,547 in 2011, and 4,509 in 2012), which resulted in inseason restrictions in the freshwater and marine sport fisheries. During these years, low run sizes of Chinook salmon were observed in other Cook Inlet tributaries.

In 2010, a SEG range of 3,800 to 10,000 was established based on spawner-recruit analysis updated with escapement data through 2010 and age composition and harvest data collected through 2009 (Szarzi et al 2010). The lower end of the SEG of 3,800 is the point estimate (posterior median) of S_{MSY} from the analysis. The upper end of the range of 10,000 is the point estimate of carrying capacity from the analysis. The SEG range of 3,800 to 10,000 minimizes the risk of overfishing by establishing the lower bound at the point that maximizes the likelihood of achieving maximum sustained yield and yet allows liberalization of the harvest when escapements are large.

In November 2010, the BOF met and considered a suite of public proposals that would roll back liberalizations implemented in 2007. The proposals were likely a response to escapements in 2008-2010 that were near or below the current SEG of 5,000. The BOF extended the closed area north and south of the mouth from 1 mile to 2 miles, and returned the annual limit of Chinook salmon over 20 inches in length to 2 in combination with Deep Creek.

Chinook salmon will be monitored in 2013 using the DIDSON and the resistance board weir. Beginning in 2011, Chinook salmon were counted through the weir using an underwater video camera attached to the weir; the quality of the video footage is such that speciation is possible. Use of the camera will allow Chinook salmon to pass through the weir as they arrive, 24 hours a day, allowing a more uniform migration through the weir.

OBJECTIVES

1. Estimate the adult Chinook salmon escapement that passes upstream of RKM 2.8 on the Anchor River from approximately May 13 through August 4, 2013 within 5% of the true value 95% of the time.

2. Estimate the age and sex composition of the escapement of Chinook salmon into the Anchor River upstream of rkm 2.8 within 10 percentage points of the true values 95% of the time.

SECONDARY OBJECTIVES

1. Estimate length-at-age of the escapement of Chinook salmon into the Anchor River upstream of rkm 2.8.
2. Examine all Chinook salmon sampled for age, sex and length (ASL) data and observed on video recordings for an adipose fin.
3. Examine between-reader and within reader variation of the DIDSON counts used to estimate the escapement
4. Determine diel run timing of Chinook salmon during DIDSON and weir operations.
5. Measure water depth and temperature throughout the DIDSON and mainstem weir operations.

METHODS

STUDY DESIGN

A DIDSON system will be installed and operated at rkm 2.8 on the Anchor River mainstem during May and part of June, when high water prevents installation of a full weir (Figure 2). During the DIDSON operation, beach seine surveys on the North and South forks will be used to capture Chinook salmon for ASL data. Once the high water period has passed, a resistance board weir will be installed near the DIDSON site to census the remainder of the Chinook salmon escapement through August 4. An underwater video system will be installed in a passage chute on the weir and motion detected fish passage will be recorded 24 hours per day seven days each week, and stored video files will be reviewed daily. A live box will be attached to the weir and used to capture Chinook salmon for ASL data. The overall age composition for the Anchor River Chinook salmon escapement will be estimated by weighting the age composition calculated from the DIDSON and resistance board weir periods. The weights for this procedure will be proportional to the Chinook salmon passage during each of those periods.

The following sections outline the sample design for the DIDSON, resistance board weir, and beach seining (Objectives 1 and 2).

ESCAPEMENT COUNTING AND SAMPLING

DIDSON and Partial Picket Weir

Before the DIDSON is deployed, a fixed partial picket weir will be installed on the sloping right bank (length ~ 10 m) and left cut bank (length ~ 4 m) to direct fish past the DIDSON's ensonification path (length ~ 17 m Figure 2). The right bank is defined as the right side of the river when facing downstream. All bottom irregularities at the base of the weirs will be sealed with sandbags. The DIDSON will be fitted with an ultra-high resolution large lens (large lens). The large lens almost doubles the resolution over the standard lens, which was used from 2003 to 2008. After the large lens is attached, the DIDSON will be enclosed in a silt box and then secured on a field goal post upstream of the right bank partial weir and approximately 2 m from the offshore end of the weir. The DIDSON cables will be strung from the left bank to the right bank and secured to the top of the partial weir. A mast will be secured to the end of each weir to allow the cables to suspend above the open area between the partial weirs.

The DIDSON software (version 5.24.18-Std_rev5-88, provided by Sound Metrics Corporation) will be programmed to record fish passage between the two partial weirs 24 hours a day in three 20-minute increments for each hour, 7 days per week). River depth and velocity determines the distance each partial picket weir can be extended; the distance between the partial picket weirs determines the frequency (either high or low) at which we will set the DIDSON. At 17 m the entire range between the partial picket weirs will be initially ensonified at low frequency over the entire (refer to Appendix A 1). Fish images will be counted from the first 20-minute recording of each hour. The number of fish counted in the first 20-minutes will then be expanded to the full hour. The hourly expanded counts will then be summed to estimate daily passage of Chinook salmon over the duration of the DIDSON operation. In the event of a software malfunction with the result that the first 20-minutes of the hour is not recorded, the recording from the second or third 20-minute period will be used. In 2003 and 2011, fish images were counted for each 20-minute recording of the hour, which allowed us to compare the season total based on the sum of expanded 20-minute counts to full hour counts. As expected, the bias between the expanded 20-minute counts and full hour counts was small. (Bias for first 20-minute count = 1.69%, second=1.90%, third=3.63% (Kerkvliet et al 2008).

To ensure power to the DIDSON equipment 24 hours per day, the DIDSON will be operated using a 600 ah 12 volt battery bank. A voltage meter attached to the battery bank will be used to monitor the charge. A generator will be used to charge the battery bank to 12 volts. DIDSON files will automatically be saved to uniquely named files by date and time using the DIDSON data collection software. Files will be backed up on an external hard drive, and burned on DVD's. Each DVD will be labeled as described in (Appendix A 2). It is important to check the computer screen frequently throughout the day and at minimum 2 times per night because the DIDSON software has, on occasion, stopped collecting data. The following information should be checked to ensure data is being collected: The red light is on in the lower right corner of the screen; Frames are advancing right under "File Position"; the settings (frame rate, window length, and window start) are correct.

Mainstem Resistance Board Weir

The DIDSON will be operated until the mainstem resistance board weir is completely installed and considered fish-tight to ensure continuous escapement monitoring. Once the water level subsides, a complete resistance board weir (length ~ 31 m) will be installed approximately 1 m below the DIDSON site (Figure 2). The rail will be attached to the substrate using upstream duckbill earth anchors pounded into the river bottom using a rock hammer. All attachment eyes on the rail will be connected to two duckbill earth anchors. The end of the rail that is closest to the right bank will also be connected to a concrete anchor that is buried approximately 3 m deep into the bank. The report by Stewart (2003) will be used as a guide for installation. The gaps between the weir and live box pickets are approximately 3.8 cm (~ 1.5 inches) to block the passage of all but the smallest ocean age-1 Chinook salmon. Stewart (2002) will be used as a guide for weir construction and repairs. New weir panels will be constructed to measure 3' wide (~0.9 m) rather than 4' wide (~1.2 m). Attached to the upstream edge of the weir, a fish passage chute will be installed close to the center of the river and an underwater video system will be installed, which will allow fish to pass upstream 24 hours a day seven days a week. ASL data will be collected from fish sampled at the passage chute.

The underwater video system will be the same as that used by the USFWS in 2010 and is similar to that described by Gates and Boersma (2009). The system will be installed and operated as described by Anderson (2010) where power for the system will be provided by a combination of 12-VDC deep cycle batteries and a gasoline-powered generator. The underwater video camera will be located inside a sealed video box attached to the fish passage chute (Figure 2). The video box is constructed of 3.2-mm aluminum sheeting and is filled with distilled water. Safety glass is installed on the front of the video box to allow for a scratch-free, clear surface through which images are captured. The passage chute is constructed from aluminum angle and is enclosed in plywood isolating it from exterior light. The backdrop of the passage chute from which video images are captured can be adjusted laterally to minimize the number of fish passing through the chute at one time. The backdrop can also be easily removed from the video chute when dirty and replaced with a new one. The video box and fish passage chute are artificially lit using a pair of 12-V underwater pond lights. Pond lights are equipped with 20-W bulbs which produce a quality image and provide a consistent source of lighting during day and night hours. All video images will be recorded on an external 3 terabyte hard drive at 120 frames-per-second using a computer-based digital video recorder (DVR). The DVR is equipped with motion detection to minimize the amount of blank video footage and review time; video footage will be collected 24 hours per day.

All bottom irregularities at the base of the weir will be sealed using skirting and sand bags. The crewmember on duty will clean and inspect the weir at least once per day and more frequently if conditions warrant ensuring that it is fish tight to Chinook salmon. The crew will monitor the weir closely during daylight hours.

In June, steelhead trout may still be emigrating from the Anchor River. To allow steelhead trout to swim downstream of the resistance board weir, a “steelhead chute” will be formed by weighting the downstream end of one of the weir panels with a sand bag. The placement of the sand bag will be adjusted to allow steelhead trout to swim downstream, and to prevent immigrating fish from swimming upstream over the panel undetected. Steelhead trout and Chinook salmon will be counted opportunistically if they are observed passing downstream through the “steelhead chute”. Live Chinook salmon observed passing downstream, will be subtracted from the upstream daily count.

Beach Seining

Beach seine catches from the North and South fork will provide Chinook salmon ASL data during the DIDSON period. During the weir operation beach seine catches downsteam will also occur in the event additional ASL samples are needed. The species composition of each catch will be recorded. Beach seining will be conducted twice a week during the DIDSON period when water levels permit the safe beach seine operation. Historically the first day the North Fork was beach seined ranged from May 13 to May 25. The first day of beach seining on the South Fork ranged from May 20 to June 7.

The two crew members working the beach seine will wear dry suits. Pools are characterized by deeper water than surrounding areas (typical holding and resting areas for migrating Chinook salmon). Pools thought to have fish will be sampled in the following way (Figure 3):

Step 1) As the beach seine is deployed from the raft, the first crew member (crewmember A) will walk the end of the net that left the raft first to the cut bank side of the river

Step 2) As the beach seine is continually fed out from the raft by a second crewmember (crewmember B); crewmember A will walk the end of the net to the downstream side of the pool

Step 3) Once the beach seine is fed out of the raft, crewmember B will hold the upstream side end of the net near the sloping bank

Step 4) Meanwhile, a third crewmember (crewmember C) will plunge the water below the pool to scare fish into the beach seine from downstream until the beach seine is closed by crewmember A on the downstream side of the pool by walking the beach seine back to the sloping bank.

Following each day of beach seining, the crew will hang the beach seine to dry and will inspect the webbing for holes and the cork and lead line for loose attachments and repair as needed.

SAMPLE SIZE

Escapement

From 2004 through 2012, a mainstem resistance board weir was installed once high water had subsided, allowing a census of the Chinook salmon count thereafter. Using successive difference variance formula (see later) we calculated a relative precision (95%) of 4% for both the 2004-2005 escapement estimates, 5% for 2006-2007 and 6% for 2008. In 2009 a resistance board weir was installed prior to any Chinook salmon immigration, providing a census of the run. The relative precision (95%) in 2010 was estimated as 4.5%. In 2011, the escapement was censused from full hour counts of DIDSON and video images. The relative precision in 2012 was estimated at 4%.

Age-Sex

Objective 2 pertains to the age and sex composition of the overall Chinook salmon migration. The estimate will be made by weighting each of the age-sex compositions determined during the DIDSON and mainstem weir operations by the number of fish counted during each operation.

Estimation of age and sex composition during the DIDSON period will be derived from pooled samples obtained from netting in the North and South forks upstream of the sonar because we have no method of weighting North and South fork samples separately. The inherent assumption we make in pooling samples is that the age composition populations are equal between forks and/or our sampling effort is proportional to the populations in the forks. From 2007 through 2010, ocean age has not been statistically significantly different between the North and South forks of the Anchor River ($P>0.09$). (We were only able to capture 13 fish during the DIDSON period in 2011 and we did not test whether age composition was different between the North and South fork). Additionally, our sampling effort is greater in the South Fork than the North Fork, providing some self weighting of samples. We therefore believe that pooling netting samples is an appropriate way to obtain a representative sample of the migration upstream of rkm 2.8 occurring during sonar operation.

Age and sex estimation during the mainstem weir operation will be derived from direct systematic sampling at the weir. Collecting systematic samples at the video weir, which allows fish to pass upstream 24 hours a day has proven more difficult than at the conventional weir, which operated from 0800 to 2359 hours. Most (52.9%) of the Chinook salmon passage occurs from 0100 to 0359 hours and (18.4%) from 1500 hours to 1959 hours. This pattern of movement meant that the conventional sampling protocol could take advantage of surges of fish that had been held up the previous night. Under the video weir protocol, the weir had to be closed for long periods to allow accumulation of fish, especially during low water conditions when

Chinook salmon tend to hold downstream of the weir in deep pools and channels. In 2013, sampling will be structured to coincide with the peak passage times cited above to optimize sampling success, and to prevent long weir closures. In the event that sample size goals are not achieved during the peak periods, additional sampling from beach seine catches downstream of the weir will be used to attain the goal. This approach was used in 2012 when 67 ASL samples were collected downstream of the weir from beach seine catches on July 9.

The minimum sample sizes required to estimate the percentages of the population by age and sex of the overall escapement of Chinook salmon to the Anchor River were calculated using Monte Carlo simulations. Sampling during the sonar and mainstem operations was simulated by the multinomial distribution. The mainstem and sonar multinomial parameter vectors were set to the 2006-2011 average age composition estimates (normalized ocean ages 2-4 during the weir period were 0.36, 0.56 and 0.08 and during the sonar period were 0.20, 0.59, and 0.21); (age compositions from the sonar and weir periods of 2009 and the sonar period of 2011 were not included due to low sample sizes. A range of paired sample sizes was considered, each consisting of the number sampled at the weir and the number sampled by netting during the sonar operation. Sampling was simulated 5000 times for each candidate pair of sample sizes, and the overall age composition (three age classes) calculated for each of the 5000 simulations as described in the Data Analysis section. The weighting used for the sonar and weir compositions were 0.55 and 0.45, respectively. These weights were calculated as the average 2006-2012 proportions of the escapement that passed rkm 2.8 before and after June 15, the anticipated time of weir installation. The value‘d’ was determined empirically for each sample size pair such that for all i:

$$P(p_i - d \le \hat{p}_i \le p_i + d) = 0.95 \tag{1}$$

where $\hat{p}_i$ is the simulated proportion of age class i and p_i is the assumed proportion of age class i in the population.

Subsets of the simulation results are shown in Table 2. The results demonstrate that a sample of 100 Chinook salmon from the mainstem weir and 50 from the netting program during sonar operation will satisfy the precision requirements of Objective 2. These sampling levels barely meet the objective criteria of objective 2, and we will therefore sample at the next level shown in Table 2 for the weir, which is easily sampled. In summary, 50 readable Chinook salmon ages are needed from the netting program and 150 from the weir. Assuming that 20% of the scales will be regenerated or un-readable, a minimum of 150/0.8=188 and 50/0.8=63 Chinook salmon must be sampled from the mainstem weir and upriver netting programs, respectively.

Table 2.–Effect of selected sample sizes on ‘d’ values

Mainstem	Sonar	d
50	50	0.104
50	100	0.088
50	150	0.082
50	200	0.078
100	50	0.092
100	100	0.073
100	150	0.067
100	200	0.061
150	50	0.088
150	100	0.068
150	150	0.060
150	200	0.056
200	50	0.083
200	100	0.065
200	150	0.057
200	200	0.052

In 2013, we anticipate operating the DIDSON through approximately early to mid-June. We also anticipate a low run size in 2013.

Similar conditions to those anticipated for 2013 last occurred in 2010, when the sonar was operated through mid-June and the run was small (Table 3). Given the historical sample size/effort data shown in Table 3, we should be able to sample at least 63 fish with the netting program in 2013 with an anticipated 6 days of effort.

Table 3.–Sample sizes and effort (Days) for netting program upstream of the Anchor River weir

Year	Sample size(Effort)	DIDSON (Dates)	Comment
2003	382 (14)	5/30-7/09	
2004	427 (5)	5/15-6/08	Weir operated on North Fork and samples collected there.
2005	155 (5)	5/13-6/03	
2006	79 (6)	5/15-6/13	Small-Late Run: weir sample size increased inseason
2007	180 (4)	5/14-6/07	
2008	91 (6)	5/13-6/16	Small-Late Run: weir sample size increased inseason
2009	NA	NA	Weir installed from outset of run.
2010	108 (5)	5/13-6/08	Small Run
2011	13 (3)	5/13-5/24	Small Run: weir installed early
2012	64 (4)	5/14-6/13	Small-Late Run: 67 samples collected through netting on July 9 downstream of the weir because of difficulties collecting salmon at the video weir live box.

With respect to the prescribed sample rate at the weir, we will assume the lowest escapement so far observed (3,455 in 2009) and will assume that 0.54 of the escapement will pass during sonar operation. We will therefore expect to sample about 0.12 (188/ (3,455*0.46)) of the passage through the weir. We will sample fish every other day. The number of Chinook salmon to sample will be calculated as the product of 0.12 and the number of Chinook salmon counted through the weir in the previous two days. Sampling will occur from 1500 to 1959 hours and 0000 to 0259 hours. Chinook salmon will be sampled continuously during this period. If an insufficient number of Chinook salmon are sampled at the 0.12 rate, every Chinook salmon were be sampled during the sampling hours. If more samples are needed, additional Chinook salmon from beach seine catches downstream of the weir will be sampled.

DATA COLLECTION

The historic run timing of Chinook salmon into the Anchor River was used to determine dates of the DIDSON and weir operation. The beginning of May 13 (Monday) and ending date of August 4 (Sunday) was chosen based on historical Chinook salmon run timing from 2004 to 2011. Less than 1% of the Chinook salmon escapement was estimated to pass on the first day of operation (May 15, May 13, May 15, May 15, May 13, May 13, May 13, and May 13 for 2004 to 2011, respectively). And less than 1% of the Chinook salmon escapement was estimated to pass after August 6 from 2004 to 2011. In 2012 the weir was operated through August 3 and less than 1% of the Chinook salmon was counted during the last three days of weir operation.

Escapement Counting

DIDSON Counts

The Chinook salmon escapement component of the DIDSON counts will be estimated by assuming:

1. All upstream images are Chinook salmon. Violations of this assumption by migrating pink salmon during the sonar period will be detectable from the beach seine samples taken upriver of the sonar.
2. All downstream images are Chinook salmon. Even though beach seine catches of kelts above the sonar indicate that some portion of the downstream sonar images are really steelhead kelts, we have several pieces of evidence that suggest that any bias introduced by this assumption is minimal.

   - Larsen (1993) counted 1,261 steelhead migrating into the Anchor River in 1992 and in 1983 Wallis and Balland measured a survival rate of 33%. Even if the estimated survival is higher, say 50%, then 630 downstream moving kelts is a relatively small proportion of the total Chinook salmon count at current escapement levels. In 2011, the USFWS (Anderson, personal communication) counted 144 (respectively) steelhead trout migrating into the river until September 29. Using the conservative 50% survival rate, results in about 72 outmigrating kelts the following year; the immigration was not, however, likely complete by the time the weir was removed.
   - We typically do not see a discontinuity in the Chinook salmon counts at the time of transition from sonar to weir (except in 2007). If steelhead were a significant component of downstream images, then we would expect to observe a sudden increase in Chinook counts once the weir was installed, at which time all species are

identifiable. In 2007 we saw ~2-fold decrease in the 3-day average Chinook salmon counts after the weir was installed. The sudden decrease coincided with decreasing river levels and the weekend fishery openings.

- Daily downstream movement counts are highly correlated with upstream counts (r=0.93), suggestive that downstream counts are related to upstream moving targets, i.e. Chinook salmon. Part of this correlation is explained by a diel pattern of upstream/downstream movement. At night both upstream and downstream counts are high and are low during the day. This pattern is maintained through any kelt outmigration period, suggesting the downstream counts are not significantly caused by kelts.
- DIDSON downstream images are often associated with a fish migrating upstream, not leaving the sonar imaging device completely and then backing down (personal communication, Tom Kerns Alaska Dept. of Fish and Game, Homer). Thus, many downstream images are directly related to upstream migrating Chinook salmon.

Note that length distributions of Chinook salmon and steelhead kelts (as determined from beach seine samples) are insufficiently different to entertain a length-based mixture model for estimation of the proportion of downstream images that are Chinook salmon versus steelhead kelts. See Fleischman and Burwen (2002) for an example of such a mixture model analysis.

Daily upstream and downstream counts will be keyed punched into a Microsoft Access database using the data entry structure detailed in Appendix B1. The daily net counts (upstream-downstream) and expanded counts will be automatically summarized from a query. During each new shift, crewmembers will review the data collected during the shift before for completeness.

Mainstem Resistance Board Weir Counts

Once the resistance board weir is fish tight, the partial picket weirs and DIDSON equipment will be removed. Thereafter, a census of all but the smallest ocean age-1 Chinook salmon will be attained from live box catches. The number of small Chinook salmon that are able to swim through the weir pickets is unknown, but if present their contribution to the escapement is thought to be small.

Fish will be passed continuously through the weir and daily passage counts will be tallied by reviewing motion-triggered video files. The DVR is equipped with motion detection to minimize the amount of blank video footage and review time; video footage will be collected 24 hours per day. The motion detection facility of the DVR will be evaluated for 1 hour each day. The DVR also has numerous file review features that assist in identification and counting of passing fish. The image can be played forwards or backwards at various speeds, or paused and zoomed to assist in counting or species identification. Once all fish in a file are identified and counted, the next file will be reviewed. Video files will be reviewed sequentially until all fish passing through the video passage chute are identified and counted. Numbers of each species will be tallied by sex (when possible) each hour, and hourly counts will be summed for a daily total. Daily escapement counts will be relayed to ADF&G in Homer by 0830 hour via cellular telephone.

All escapement counts, ASL, and CWT sample data will be entered into the Access database using the data entry structure detailed in Appendix B2. Daily fish counts and biological sample data will be summarized in Access and daily fish counts also summarized inseason automatically using an Access query. During each new shift, crewmembers will review the data collected during the shift before for completeness. Post-season, all data will be imported into a master Access database that has been used to store the data collected for the Anchor River since 2003. After the data is imported, counts will be proofed before analysis begins.

Water Depth and Temperature

Water level (nearest cm), temperature (Celsius), will be taken twice daily at approximately 1000 and 1900 hours, recorded in Rite'n Rain© field books and then entered into the Access database. These inseason measurements are used as crude predictors of imminent fish passage rates (Kerkvliet and Booz 2012). In general fish passage tends to increase during rising water. General observations such as percent cloud cover and precipitation will also be collected for each 24 hour period. During the DIDSON operation, a staff gauge will be installed downstream of the partial weir on the left bank. When the full weir is installed, a meter stick will be attached to the deep water (center) live box. The depth measurements from the left bank gauge will then be calibrated to the depth at the center live box gauge. Thereafter water depth will be recorded from the live box gauge. A hand held thermometer will be used to measure the daily water temperature (^{o}C).

Cook Inlet Keeper (CIK) will install a data logger at the Lower Anchor River (AR-3) site, which is near the weir site (Mauger 2005). The data logger will collect water temperature data every 15 minutes from May through September. The temperature data will be downloaded post season by CIK and made available to the project leader. The U.S. Geological Survey (USGS) will also collect river stage readings hourly from a gauge station (USGS 15239900) located on the South Fork approximately 11.4 rkm.

Biological Samples

Biological samples of the Chinook salmon escapement will be collected upstream of the DIDSON site on the South and North fork by beach seine, and at the resistance board weir on the mainstem. The following guidelines must be followed to minimize handling stress when sampling the beach seine or live box catch: 1) do not remove fish from water unless necessary, 2) process each fish as quickly as possible, and 3) provide a recovery area for the fish.

The data collected using beach seines will be recorded in a Rite'n Rain© book then entered the following day into the Access database using the data entry structure outlined in Appendix B1.

Age, Sex and Length Samples

Chinook salmon will be sampled for age, sex and length (ASL) at each sampling location using the following methods:
Age: three scales will be removed following the methods of Welander (1940) and Scarnecchia (1979). If scales are not present on the left side preferred area, then the right side preferred area will be used as an alternate (Appendix C1). Scale samples will be placed on gum cards with the first three scales placed on numbers 1, 11 and 21; the second three scales on numbers 2.
Scale cards will be numbered sequentially from (1, 2, 3…n+1) by species. Scale cards will be pre-labeled before sampling. After sampling, scales will be inspected to insure their cleanliness and orientation before mounting. Scale cards will then be dried. Common problems encountered with inexperienced scale collectors are listed in Appendix C2.

Gum cards will be impressed into cellulose acetate cards (Clutter and Whitesel 1956). Scales will be pressed and the age determined using procedures described by Mosher (1969). Before scales are aged, the scale reader will be given a reference set of 200 scales to age from a historic data set. Scales will be aged following the criteria described in Appendix C 3 -Scale Interpretation training and refresher procedure

Ages determined from the test set by the scale reader will be compared to the previous (reference) age estimates. Ages that do not match will be reviewed and the scale re-read. Once the reader ages are resolved and equal to the test set ages then the reader will begin with the collected samples from the current season. Age estimates will be produced without knowledge of size, sex, and other age estimates. Scale samples will be aged twice to estimate within reader precision. All scale samples that had conflicting ages for the two estimates will be re-aged to produce a resolved age which will be used for composition and abundance estimates.
Sex: will be determined by external physical characteristics, such as kype development, or a protruding ovipositor.

Length: these measurements will be made from mid-eye to fork of tail (MEFT) to the nearest 5 millimeter). In addition to measuring the length of fish sampled for age and sex, length data will be taken from the DVR footage. The backdrop of the underwater video system will be marked to allow us to evaluate the length distribution of Chinook salmon during the video operation. Three marks will be inscribed on the backdrop that will be used to categorize fish as <500 mm, 500-700 mm, 700-900 mm and >900 mm. We will compare length distributions determined from ASL sampling to those obtained from the DVR; a chi-square test of independence between length composition and sample source will be used. Differences between sampling source will be interpreted as a sign that our ASL sampling protocol needs adjusting.

Beach Seine Sample

For beach seine samples, ASL data will be collected on all captured Chinook salmon. To prevent double sampling, Chinook salmon will receive a caudal fin clip.

Mainstem Resistance Board Weir Samples

For weir samples, ASL data will be collected based on an anticipated sampling fraction and the previous two days' count for Chinook salmon.

Coded-Wire-Tag Samples

Stray Chinook salmon in the Anchor River have been detected since 2003 through sampling the escapement for missing adipose fins (5 Chinook salmon have been detected). In 2013, the DVR images of fish will be examined for missing adipose fins and will be documented. Fish missing an adipose fin in ASL samples will be sacrificed. The weir crew and crew leader will verify cinch strap numbers on the heads and will fill out a Coded Wire Tag Sampling Form (Appendix D1, D2). The heads will be frozen and later shipped along with copies of the Coded Wire Tag Sampling Form and the Coded Wire Tag Head Shipment Summary Form (Appendix D3) to the Tag Lab.

Sacrificed fish will be preserved on ice until it is donated to the Anchor Point Senior Citizens Center (235-7786), preferably the day it is sacrificed.

DATA REDUCTION

DIDSON Counts

A five-step process will be followed to prevent data loss and ensure accurate enumeration of the Chinook salmon escapement from DIDSON data files (*.DDF).

DIDSON files will be backed up in the following way:

- Every 12-hours (0000 and 1200 hours) the person on shift will make a backup copy of the DISDON files and place them in the folder for that day. One backup will be saved to an external hard drive and the second to a DVD.
- When the hard drive is full (~ 9 days), the drive will be switched-out with a spare drive and brought to the office by field staff. Sufficient hard drive space is available to archive all 20-minute samples recorded.

Each day the crewmembers on duty will review DIDSON files and tally the number of fish moving upstream and downstream to estimate the daily Chinook salmon escapement and to determine reader variability (Task 3). The DIDSON files will be processed in the following way:

1. Daily Chinook salmon estimates will be based on 8 hours of data (one 20-minute count for each of 24 hours) where the number of fish moving upstream and downstream are counted then key punched into the Access database using the data structure outlined in Appendix B1. It is anticipated that it will take approximately 5 hours to perform this duty.
2. Between-reader variability will be based on 1 hour of data (3 DIDSON files of 20 minute counts) from daily files. An Access query will be used to select the 3 files. The files will be recounted by a crewmember that did not do the initial count. The recount will then be keyed into the Access database using the data structure outlined in Appendix B1.
3. Within reader variability will be based on the same 3 DIDSON files used to evaluate between reader variability. The files will be recounted by the crewmember that did the initial count. The recount will then be keyed into the Access database using the data structure outlined in Appendix B1.

DIDSON Count Adjustments

Counts may be adjusted in three ways: 1) All counts made for less than 20-minutes in an hour will be expanded to a full 20-minutes and then to the full hour, 2) missing hourly counts, caused by flooding, computer malfunctions or unreadable files, will be interpolated based on counts before and after the data gap (see below), and 3) postseason, if we believe our assumption that all upstream images are Chinook salmon has been violated, we may subtract the estimated number of non-Chinook salmon species we believe migrated upstream during the sonar period from the DIDSON count. The raw DIDSON counts will be automatically expanded to the hour in the Access database (Appendix B 1). Interpolated full hour counts (point 2) above) for hour (military time) j will be made according to the following:

$$\hat{I}_j = C_k + \left[\frac{C_m - C_k}{m - k}\right]\left[j - k\right] \tag{2}$$

where

C_x= Count in hour x,

k= Last full hour (miltary time, e.g. 1500) for which a count is available (j>k),

m= Next full hour (e,g, 1700) for which a count is available (j<m)

When interpolation is required, two countable hours immediately before and following the uncounted period will be counted completely (i.e. the full 60 minutes is counted) to help mitigate any increased variance/bias the interpolation incurred.

Should data be missing for longer periods, such that diel timing begins to affect the interpolation, then a modified version of Equation 2) will be used. The before/after counted periods will be those representing the same times of day as the missing data, but from the day previous and the day after the day of missing data. For example, if the missing data are from 300 through 1100 hours on Tuesday, then the missing data will be interpolated as the average of the counts from 300-1100 hours from Monday and Wednesday; this calculation prevents diel timing effects on the interpolation.

The number of hours for which there is no count is very small and these adjustments are not thought to contribute any meaningful bias or variance to the season-end estimate. The DIDSON count data will be loaded into an Access database in September for final editing.

Mainstem Weir Counts and Hydrological and Biological Samples

Mainstem weir counts and biological and water data will be entered into an Access database.

Archiving

All data will be appended to tables within an Access database (AnchorRiver_master.mdb) for final editing and will be stored on the local network O-drive in the Homer office.

Inseason Reporting and Summaries

Field notes are an extremely important means to communicate activities and conditions to crewmembers. Furthermore, field notes can be extremely valuable post-season in evaluating data. The crew will write field notes that should include the following: date, day of week, first and last name, and general weather and water conditions. Notes should also include details on the following: changes to DIDSON settings and adjustments, weir conditions and maintenance, any observation or change that would affect data, daily activities. The daily activity notes should include “who, what, when, and why” information.

Daily counts by species and water data will be summarized in Access reports. The following information will be reported to the Homer ADF&G Office before 0800 the following day (except holidays and weekends):

1. The net upstream number of fish by species.
2. Water depth and temperature.
3. The number of Chinook salmon sampled for ASL data.
4. The number of CWT samples collected and number of fish examined for missing an adipose fins.
5. Any comments regarding the ability to accurately collect escapement counts.

DATA ANALYSIS

Chinook Salmon Escapement: Objective 1

A DIDSON sonar will be used during periods of high water, until a resistance board weir can be installed that allows a census of the Chinook salmon count thereafter.

Net upstream passage during DIDSON operation for hour j in day i will be calculated as:

$$n_{ij} = u_{ij} - d_{ij} \tag{3}$$

where:

u_{ij} = upstream count for the counted period in hour j within day i
d_{ij} = downstream count for the counted period in hour j within day i.

The total estimated count for each day will be calculated as:

$$\hat{C}_i = P_i \frac{\sum_{j=1}^{p_i} n_{ij}}{p_i} \tag{4}$$

where:

p_i = number of (twenty-minute) counting periods conducted within day i (by design = 24); and

P_i = total number (twenty-minute) counting periods that could be sampled within day i (by design = 72).

The total estimated count for the period covered by the DIDSON will be calculated as:

$$\hat{N}_D = \sum_{i=1}^{L} \hat{C}_i \tag{5}$$

where:

L = number of days in the season covered by the DIDSON counting process.

The variance of the estimated daily count will be calculated as (Cochran 1977):

$$\mathrm{var}\left(\hat{C}_i\right) = \left(1 - {p_i}/{P_i}\right) P_i^2 \frac{s_i^2}{p_i} \tag{6}$$

where:

s_i^2 = the sample variance for counts within a day which is approximated using the successive differences estimator appropriate for systematic sampling (see Wolter 1985):

$$s_i^2 = \frac{\sum_{j=2}^{p_i} \left(n_{ij} - n_{i(j-1)}\right)^2}{2\left(p_i - 1\right)} \tag{7}$$

The variance for the estimated count for the entire season covered by the DIDSON will be calculated as the sum of the daily variances as:

$$\mathrm{var}\left(\hat{N}_D\right) = \sum_{i=1}^{L} \mathrm{var}\left(\hat{C}_i\right) \tag{8}$$

The estimated total Chinook salmon passage over the entire season will be calculated as

$$\hat{N}_T = \hat{N}_D + N_W \tag{9}$$

where N_W is the count of Chinook salmon through the full weir; the variance of $\hat{\mathrm{N}}_{\mathrm{T}}$ will be estimated as

$$\mathrm{var}(\hat{N}_T) = \mathrm{var}(\hat{N}_D) \tag{10}$$

Reader Variability: Task 3

To evaluate between-reader variability, the total upstream, downstream, and net counts of each crewmember will be re-counted by a second crewmember for a given set of DIDSON files.

The following statistics will be calculated for the between- reader analysis:

1. Kendall's Tau for each pair of readers counting the same files, as well as for all first and second readings. (Kendall's Tau ranges from -1 to 1, representing perfect negative and positive correlation, respectively).
2. Intraclass correlation coefficient for each pair of readers counting the same files. This statistic is a function of the correlation <u>and agreement</u> between readers. It ranges from 0 to 1; it is high when there is little variation between the scores given to each file by the readers and vice versa.
3. A Tukey-Difference plot for each pair of readers counting the same files. These plots are of differences between readers against the average of the scores of the readers.

A within-reader analysis analogous to 1), 2) and 3) above will also be conducted.

Diel Passage: Task 4

Diel migration of Chinook salmon and steelhead trout will be determined using hourly upstream and downstream DIDSON and underwater video counts collected for each day.

Age and Sex Composition Chinook Salmon: Objective 2

The age and sex, composition of the Chinook salmon escapement is based on a combination of samples collected upstream of rkm 2.8 during each of the sonar (D) and mainstem weir operations (W).

Age and Sex composition for discrete periods

The estimated proportion of Chinook salmon of age or sex class k (or combination of), in the escapement during a given period X (X=W (Weir) or D (DIDSON)) will be calculated by:

$$\hat{p}_{xk} = \frac{n_{xk}}{n_x} \tag{12}$$

where

n_{xk} = the total number of salmon of age or sex class k in n_x and

n_x = the number of salmon sampled during period X.

Age and Sex composition for entire escapement

Contingency table analysis will be conducted to test for differences in composition between the sonar and weir periods. If no differences are found, then composition will be estimated from pooled samples as shown in equation 12, with subscript x deleted. If differences are found, the estimated proportion of Chinook salmon of age or sex class k (or combination of) in the entire escapement to the Anchor River will be calculated as:

$$\hat{p}_k = \phi_D \hat{p}_{Dk} + (1-\phi_D)\hat{p}_{Wk} \tag{13}$$

where:

ϕ_D = the proportion of the entire escapement that migrates during the DIDSON operation, and

The estimated variance of proportion ($\hat{p}_k$) will be calculated as:

$$V\hat{a}r(\hat{p}_k) = \phi_D^2\left[\left(\frac{\hat{N}_D - n_D}{\hat{N}_D}\right)\frac{\hat{p}_{Dk}(1-\hat{p}_{Dk})}{n_D - 1}\right] + (1-\phi_D)^2\left(\frac{N_W - n_W}{N_W}\right)\frac{\hat{p}_{Wk}(1-\hat{p}_{Wk})}{n_W - 1} \tag{14}$$

The estimated total number of Chinook salmon of age or sex class k will be calculated as:

$$\hat{N}_k = \hat{N}_T \hat{p}_k \tag{15}$$

The estimated variance of $\hat{N}_k$ will be calculated as (Goodman 1960):

$$V\hat{a}r(\hat{N}_k) = \hat{N}_T^{\,2} V\hat{a}r(\hat{p}_k) + \hat{p}_k^2 V\hat{a}r(\hat{N}_T) - V\hat{a}r(\hat{p}_k) V\hat{a}r(\hat{N}_T) \tag{16}$$

SCHEDULES AND DELIVERABLES

Crew schedules from April through August 7 are outlined in Appendix E1.

Date	Activities
May 1–May 11	Install field camp and partial weir
May 1	DIDSON installation and training
May 13 – June?	Beach Seine South and North Fork once per week pending river levels and continue throughout DIDSON operation.
Early-Mid-June	Install floating weir (pending river levels)
August 6	Remove weir
October – January	Anchor River 2013 Chinook salmon escapement analysis.

RESPONSIBILITIES

List of Personnel and Duties

Carol Kerkvliet, Fishery Biologist II, Project Leader- Duties: Budget manager and writes project operational plan and final report. Assists with various phases of field site development weir and DIDSON installation, supervises field staff, directs data collection and sampling. Responsible for operational plans and supervises the analysis and drafting of the year-end report, supervises field personnel. Makes discretionary decisions concerning safety, methodology and collection of field samples.

Michael Booz, Fishery Biologist I, Project Assistant- Duties: Under the supervision of the project leader. Summarize season data, read scales, and prepares inseason escapement counts. Leads daily activities of field crews, panel maintenance and construction, collect time sheets and leave slips for submission to project leader as well as coordinate staffing requirements for weir location with project leader.

Kelsey Kleine, Fishery Technician III- Duties: The project crewleader working under the supervision of the project leader. Is responsible for the daily operation of the DIDSON and mainstem weir. Trouble shoots DIDSON malfunctions, directs field crew, and procures equipment, responsible for fabrication of field station. Collects and records data as outlined in the operational plan. Ensures data is reviewed for completeness and error checking inseason. Maintains the field camp.

Jon Kee, Fishery Technician III- Duties: Works under the general supervision of the project leader. Is responsible for operating the weir. Collects and records data as outlined in the operational plan. Maintains the field camp.

Holly Dickson, Fishery Technician II- Duties: Works under the general supervision of the project leader. Is responsible for operating the weir. Collects and records data as outlined in the operational plan. Maintains the field camp.

Vacant, Fishery Technician II- Duties: Works under the general supervision of the project leader and is directed by the crewleader. Is responsible for operating the weir/DIDSON and is *a member of the netting crew. Collects and records data as outlined in the operational plan. Maintains the field camp.*

Debby Burwen FB III, DIDSON Consultant- Duties: Provides DIDSON operation training and support to project personnel. Provides technical assistance regarding DIDSON set-up, operation, and trouble-shooting.

David Evans, Biometrician III- Duties: Provides technical assistance with statistical procedures and sample designs. Reviews and recommends procedures for data analysis. Edits operational plan and Technical Data Report.

Budget

Projected FY2013 Costs:

Line	Category	Total Budget ($K)
100	Personnel Services	113.7
200	Travel	1.0
300	Contractual	7.0
400	Commodities	8.7
500	Equipment	0.0
Total		141.3

REFERENCES CITED

Anderson, J. 2010. Anchor River salmon habitat assessment investigation plan, 2010. Kenai Fish and Wildlife Field Office, Soldotna.

ADF&G (Alaska Department of Fish and Game). 1990. A review of steelhead in Alaska, an interagency report. International symposium on steelhead management pages 1-25 [*in*] International Symposium on Steelhead Trout Management, Pacific State Marine Fisheries Commission and Association of Northwest Steelheaders, Portland.

Burwen, D. L., S. J. Fleischman, and J. D. Miller. 2007. Evaluation of a dual-frequency imaging sonar for estimating fish size in the Kenai River. Alaska Department of Fish and Game, Fishery Data Series No. 07 44, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds07-44.pdf

Clutter, R., and L. Whitesel. 1956. Collection and interpretation of sockeye salmon scales. International Pacific Salmon Commission, Bulletin 9. Westminster, British Columbia, Canada.

Cochran, W. G. 1977. Sampling techniques, *third edition.* New York., John Wiley and Sons.

Gates K.S. and J.K. June 2010 Boersma Spawning and Seasonal Distribution of Adult Steelhead in Southcentral Alaska's Kasilof River Watershed from 2007 to 2009. Fisheries Data Series Report Number 2010-06. (pdf)

Goodman, L. A. 1960. On the exact variance of products. Journal of the American Statistical Association 55:708-713.

Kerkvliet, C., M., D. Burwen, and R. Begich. 2008. Anchor River 2003 and 2004 Chinook salmon and 2004 coho salmon escapement. Alaska Department Fish and Game, Fish Data Series 08-06, Anchorage.

Kerkvliet, C., M., and D. Burwen. 2010. Anchor River 2005 and 2006 Chinook and coho salmon escapement project. Alaska Department Fish and Game, Fish Data Series 10-26, Anchorage.

Kerkvliet, C. M., M. Booz, and D. Burwen. *In prep*. Anchor River 2007 and 2008 Chinook and coho salmon escapement. Alaska Department of Fish and Game, Fisheries Data Series, Anchorage.

Kerkvliet, C. M., and M.D. Booz. 2012. Anchor River 2009 Chinook and coho salmon escapement project. Alaska Department of Fish and Game, Fisheries Data Series 12-07, Anchorage.

Stewart, R. 2002. Resistance board weir panel construction manual, 2002. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 3A02-21, Anchorage. http://www.sf.adfg.state.ak.us/FedAidpdfs/RIR.3A.2002.21.pdf

Stewart, R. 2003. Techniques for installing a resistance board fish weir. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 3A03-26, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/RIR.3A.2003.26.pdf

Szarzi, N. J., S. J. Fleischman, R. A. Clark, and C. M. Kerkvliet. 2007. Stock status and recommended escapement goal for Anchor River Chinook salmon. Alaska Department of Fish and Game, Fishery Manuscript No. 07-05, Anchorage. http://www.sf.adfg.state.ak.us/FedAidpdfs/fms07-05

Szarzi, N. J., C. M. Kerkvliet, B. J. Failor and M. D. Booz. 2010. Recreational fisheries in the Lower Cook Inlet Management Area, 2008-2010, with updates for 2007. Alaska Department of Fish and Game, Fishery Management Report No. 10-38, Anchorage.

Wolter, K. M. 1985. Introduction to variance estimation. Springer-Verlag, New York

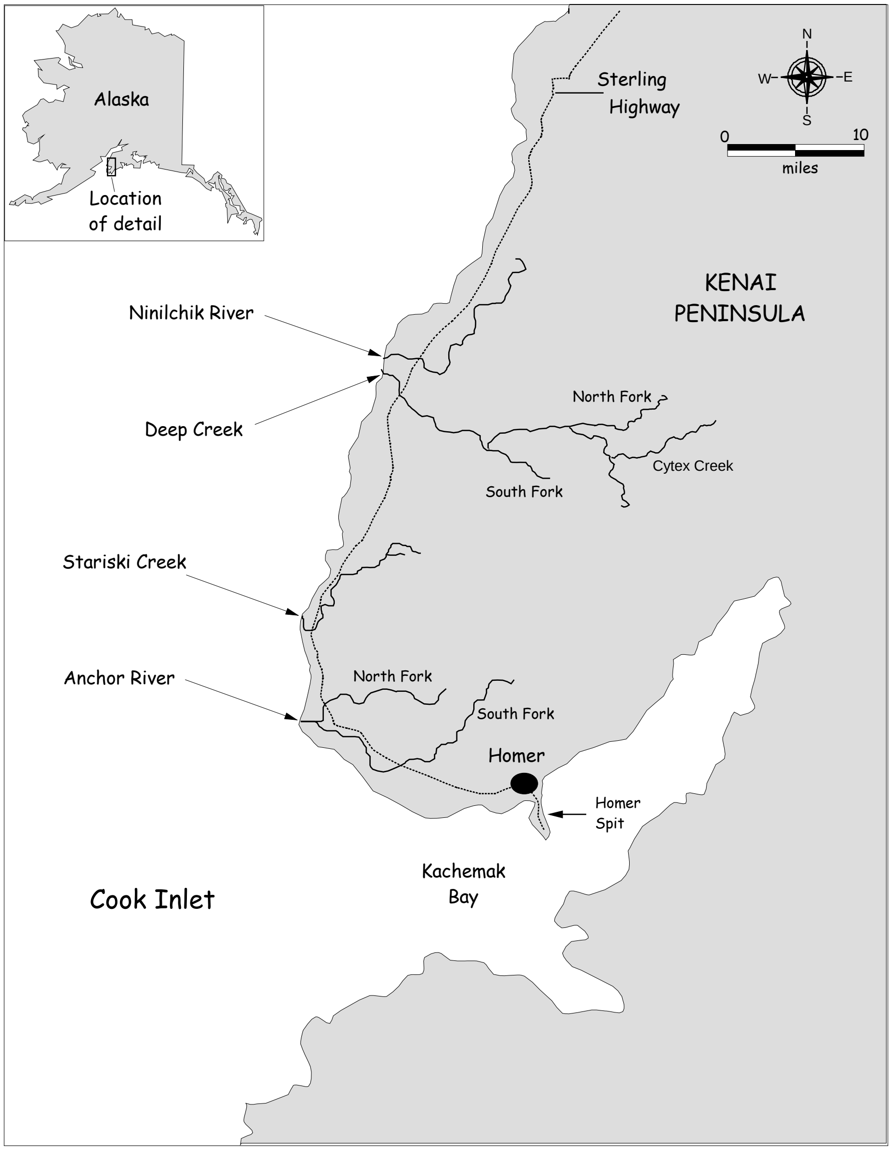


Figure 1.-Location of the Anchor River and other Lower Cook Inlet roadside tributaries.

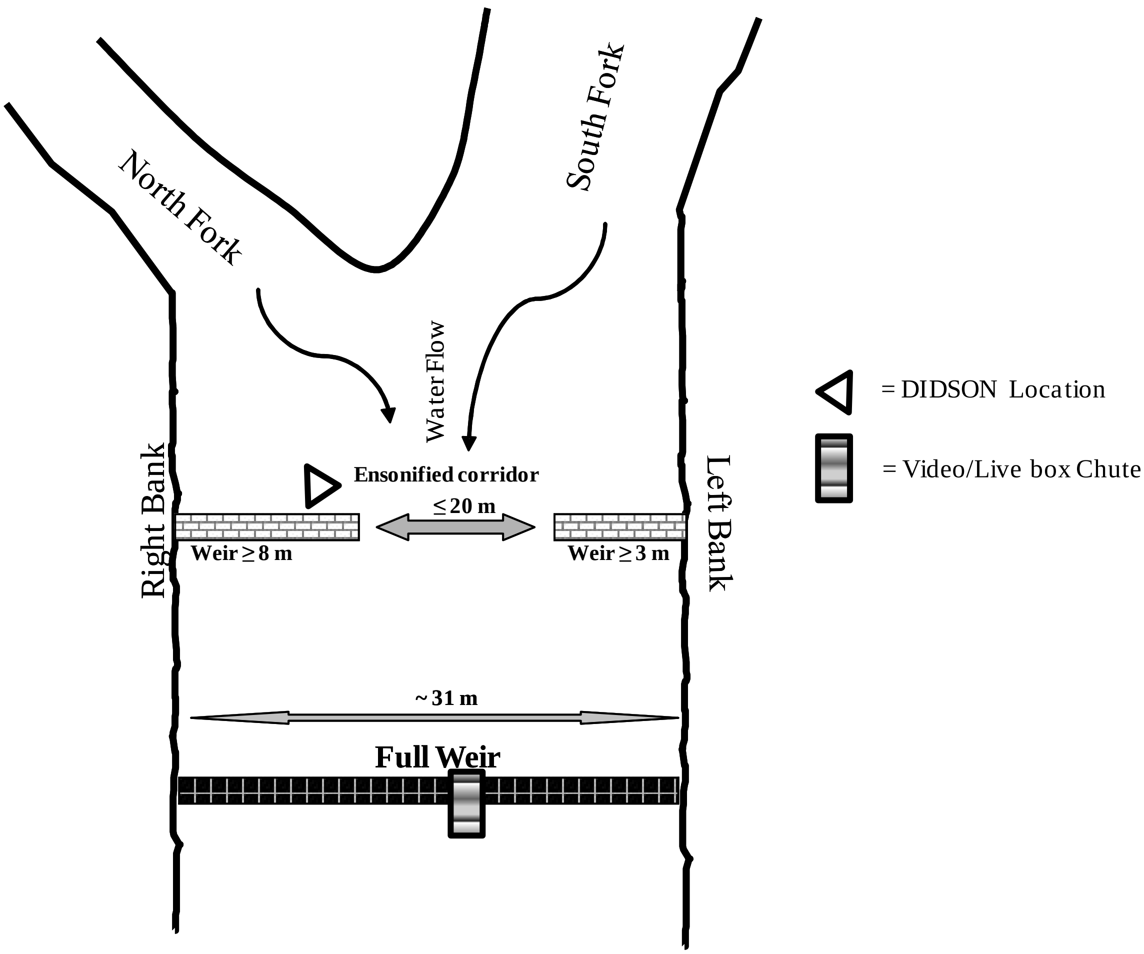
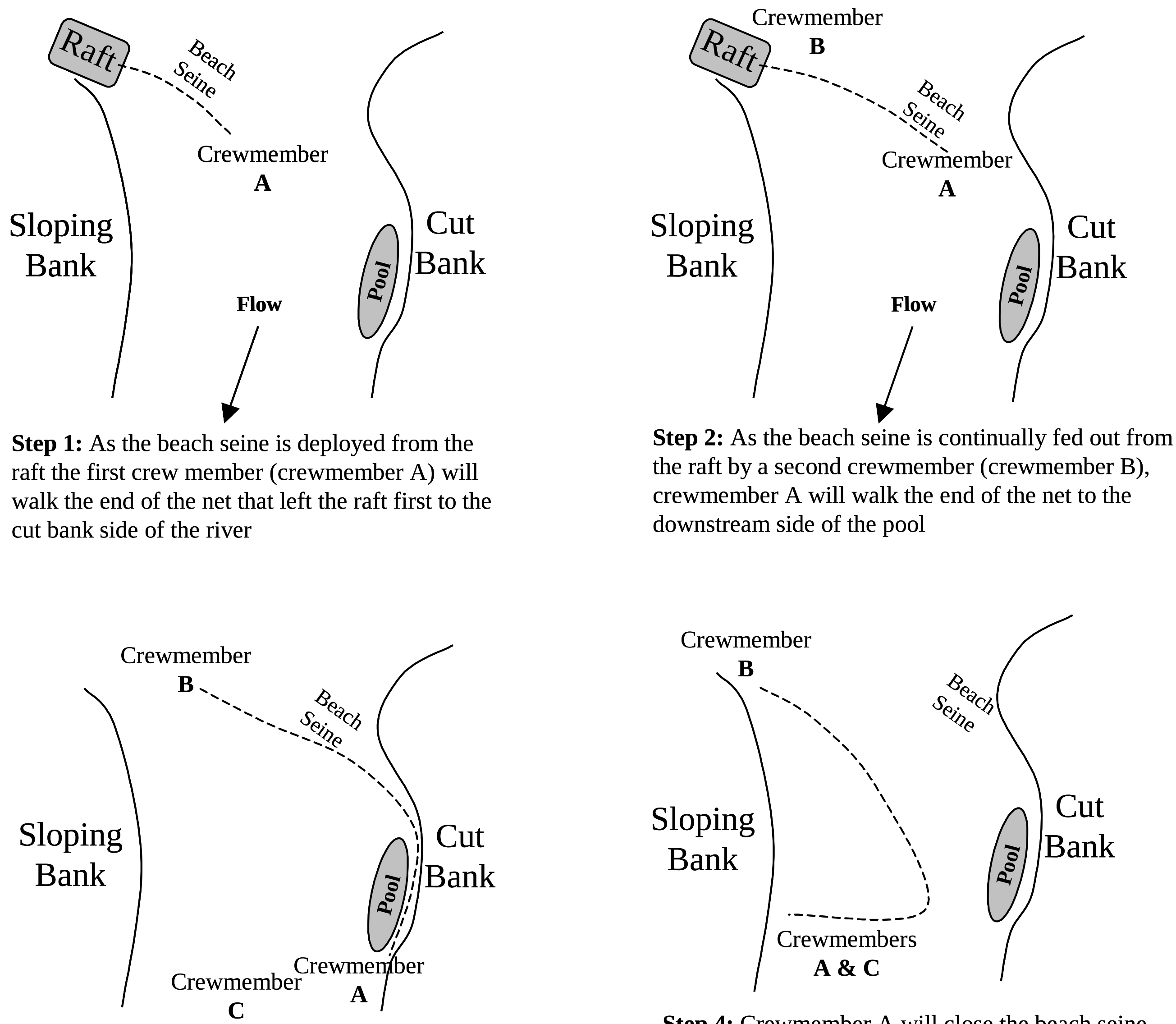


Figure 2.- Locations of the mainstem DIDSON, partial weirs and mainstem full weir site on the mainstem at approximately 2.8 rkm from the mouth of the Anchor River, 2012.



Step 1: As the beach seine is deployed from the raft the first crew member (crewmember A) will walk the end of the net that left the raft first to the cut bank side of the river

Step 2: As the beach seine is continually fed out from the raft by a second crewmember (crewmember B), crewmember A will walk the end of the net to the downstream side of the pool

Step 3: Once the beach seine is fed out of the raft, crewmember B will hold the upstream side end of the net near the sloping bank; meanwhile, a third crewmember (crewmember C) will plunge the water below the pool to scare fish into the beach seine

Step 4: Crewmember A will close the beach seine by walking the beach seine back to the sloping bank.

Figure 3.-Beach seining method for sampling the Anchor River.

APPENDIX A. DIDSON PROTOCOLS

Appendix A 1.-DIDSON frequency settings

The DIDSON system fitted with a large lens gives a near video quality image for observing fish underwater and is well suited for counting migrating salmon in rivers (Burwen et al. 2007). The DIDSON operates at two frequencies, 1.8 MHz for close range observations (less than 15 m) and 1.0 MHz for observations from 15 m up to 30 m. Overall beam dimensions of the large lens are 15.5^o in the horizontal axis and 4^o in the vertical axis, which are narrower than the standard lens (29^o and 12^o.respectivly). The narrower beam will reduce the surface noise caused during high flows, which will improve image quality. At high frequency (1.8 MHz), image resolution is enhanced because the image is formed using 96 beams, each 0.3^o wide, compared to low frequency (1.0 MHz) that forms the image using only 48 beams that are 0.6^o wide. Image quality is also influenced by the data collection window length, which is implemented in discrete lengths of 2.5, 5.0, 10.0, 20.0, and 40.0 m. Although images collected at smaller window lengths (2.5, 5.0, and 10.0 m) and high frequency (1.8 MHz) are preferable to low frequency (20 m and 40 m, 1.0 MHz), by using the large lens image quality will improve at low frequency. Because the Anchor River is approximate 31 m between the right and left bank at the DIDSON site, two partial picket weirs will be used to redirect fish through a 17 m ensonification range so we can operate at low frequency and have the option of using 2 window lengths (0-10 m and 10-20 m). All bottom irregularities at the base of the partial weir will be sealed using sand bags to prevented fish from migrating passed the DIDSON undetected.

The DIDSON will be fitted with communication cables then placed in a silt box. The DIDSON will then be bolted to an adjustable mast that had been welded to a steel tripod. The communication cables will then strung into the weather port and connected to the electronic equipment powered by a generator. DIDSON images will be received on a Dell desktop computer. Once the DIDSON is secured to the mast tripod assembly, the DIDSON will be deployed and the tripod anchored with two of the tripod legs oriented downstream approximately 0.5 m upstream of the left bank partial picket weir (Figure 2). The offshore distance the tripod will be anchored will be determined by where the offshore end of the left bank partial picket weir. The tripod will be anchored approximately 1 to 2 m inshore from the end of the partial picket weir in order to allow the width of the beam to spread to its full size. The DIDSON beam will then be aimed toward the end of the right bank partial picket weir. If the right bank partial picket weir can not been seen even after the DIDSON was re-aimed, we will check the alignment of the DIDSON on the mast and if necessary moved the tripod closer to the end of the left bank partial picket weir.

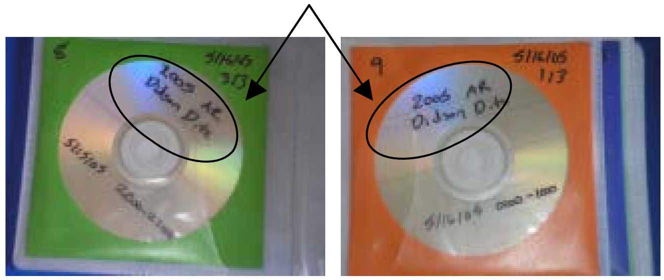
Since the area between the partial picket weirs will be set to 17 m, the DIDSON will initially be set to collect fish images at low frequencies over the entire range. If image quality is insufficient, the DIDSON will be programmed to collected data at three different ranges (described below) in three 20-minute increments for each hour to improve image quality. For the last two-20 minute files of the hour, the distance will be stratified to improve image quality. For the ranges described below, 0 m is marked by the transducer, 10m is approximately midway between the partial picket weirs, and 20 m is near the right bank of the river.

1. Low resolution images will be collected during the first 20-minutes at low frequency from 0 m to 20 m (full range). Images recorded for the full range appear small because the window length is large.

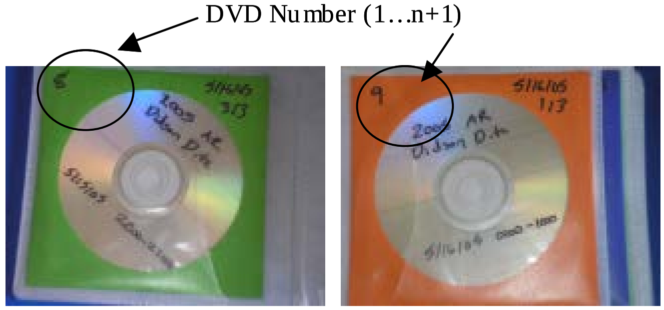
2. High resolution images will be collected during the second 20-minutes at high frequency from 0m to 10m (short range). Images recorded for the short range appear large because the window length is small.
3. High resolution images will be collected during the third 20-minutes at low frequency from 10m to 20m (long range). Images recorded for the long range appear large because the window length is small.

Appendix A 2.-DVD labeling protocol for archiving DIDSON files, Anchor River. .

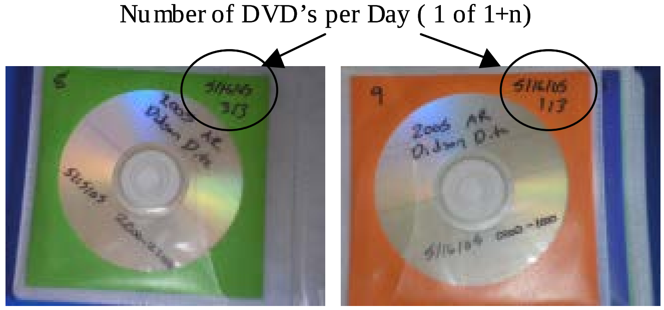
DVD Title (Year; AR = Anchor R., DIDSON DATA)



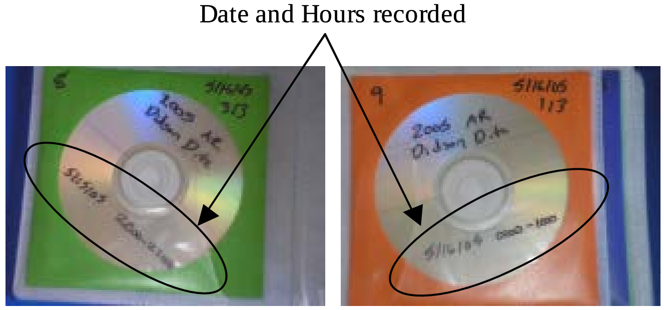
DVD Number (1…n+1)



Number of DVD’s per Day (1 of 1+n)



Date and Hours recorded



APPENDIX B. DATA ENTRY

Appendix B 1-Anchor River DIDSON data fields.

DIDSON		
Field Name	Data Type	Description
DIDSONHeaderID	AutoNumber	Unique number assigned for each day
Year	Number	Year the data was collected
Date	Date/Year	
DateComments	Memo	Notes related to the operation of the DIDSON for the day
CountTypeNew	Number	1=First Count (the sum of these counts are used to estimate abundance) 2=Within Reader Variability 3=Between Reader Variability
FileName	Text	Filename is automatically assigned by DIDSON software using the following convention: YYYY-MM-dd-hhmmss_FF.DDF Where yyyy=year; mm=month; dd=day; hh=hour; mm=minute; ss=seconds; ff=frequency (HF= high and LF=low); DDF=DIDSON software. Note, military time is used. Example: 2013-05-29-192000_HF.DDF
HourSegCounted	Number	Hour the fish passed the sonar
CountWindow	Text	
MinCounted	Number	Total number of minutes within the hour counted. Typically, this is should be equal 20 minutes. In case of a malfunction, less than 20 minutes maybe counted.
Upstream	Number	Total number of fish counted upstream
Downstream	Number	Total number of fish counted downstream
NetCount	Number	Upstream – Downstream counts
ExpandedCount	Number	NetCount (60 minutes/minutes counted)
Crew	Text	First and Last name of person who counted
HourComments	Text	Notes related to the hour counted
DVDNo	Number	DVD number used to identify the disc the data is stored. Refer to Appendix A for numbering and disc labeling convention.

Appendix B 2 -Anchor River fish counts and sampling data fields

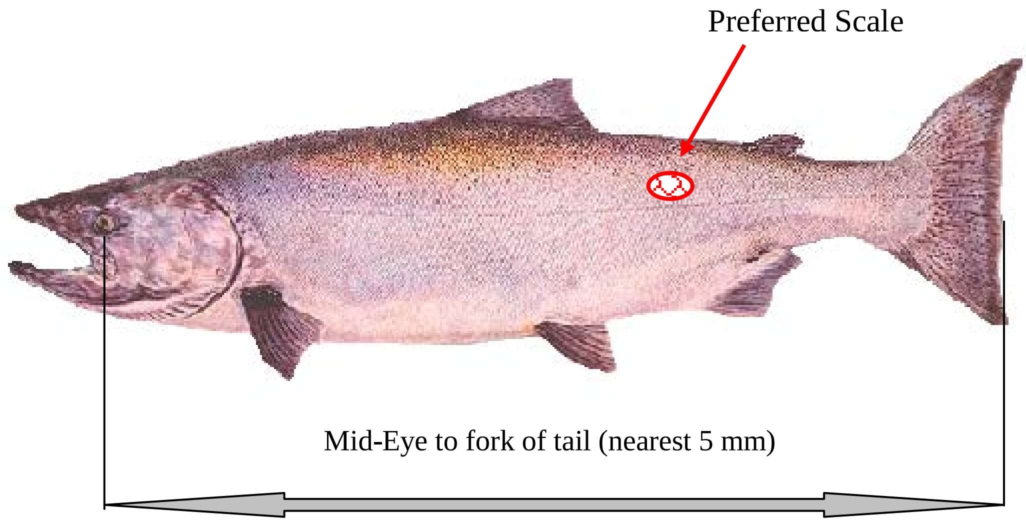
Fish Table		
Header Table		
Field Name	**Data Type**	**Description**
HeaderNo	AutoNumber	Unique number assigned for each day
Area	Number	Default to 160 for Kenai Peninsula
Site	Text	Default to P00005 for Anchor
Year	Number	Year the data was collected
Date	Date/Year	
R_Loc	Number	Location fish were sampled or counted 1=North Fork 2=South Fork 3=Mainstem Weir Site 4=Mark recapture event 1 site
Gear	Number	Gear type used to sample or count fish 1=Gillnet 3=Beach Seine 4=Weir (fish manually counted through live box…not using underwater video camera) 5=Weir Steelhead Chute 6=Weir used in combination with underwater video camera 9=Hook and line
Tide	Text	Time and height of nearest high tide
Fish Table		
Hour Counted	Number	Hour the fish was counted through the weir or hour the fish was caught for mark recapture experiment
LiveBox	Number	1=Center live box/underwater video passage chute
Species	Number	410=Chinook salmon 420=Sockeye salmon 430=Coho salmon 440=Pink salmon 450=Chum salmon 530=Dolly Varden 540=Steelhead trout 541=Rainbow trout 600=Pacific lamprey 900=Unknown or other (if “900” is entered, an explanation should be included in the comments.
NoFish	Number	Number of fish counted
Sex	Number	1=Male 2=Female 0=Unknown
EF	Number	Mid-Eye to Fork length in mm
FL	Number	Fork length in mm.
Card	Number	Scale cards will be sequentially numbered (1, 2, 3…n+1) and be pre-labeled before sampling
Col	Number	Column number (1…10)
Fate	Number	0=Released alive 3=Sacrificed for CWT sample 4=Recapture fish from mark recapture experiment

Appendix B2.–Page 2 of 2.

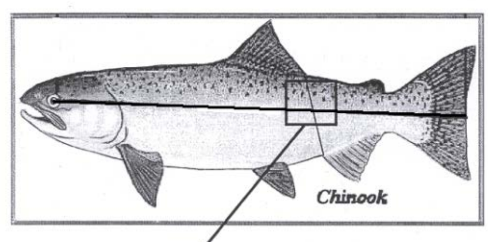
Fish Table		
Header Table		
Field Name	**Field Name**	**Field Name**
AdChecked	Number	0=**Did not** examine fish for presence of an adipose fish 1=**Did** examine fish for presence of an adipose fin
AdClip	Number	0=wild (adipose fin present 1=hatchery (adipose fin absent) 2=Partial adipose fin clip (event 1 beach seine tagged fish) 3=Hole punched adipose fin clip (event 1 hook and line tagged fish)
Caudal Clip	Number	0=No caudal clip 1=Upper caudal clip 2=Lower caudal clip
CinchStrap	Number	Unique number attached to the head of a sacrificed fish
VialNo	Number	Vial number assigned for a genetic sample
FishComments	Memo	Notes related fish counted or samples
Hole	Number	1 to n+1 (Holes are numbered from upstream to downstream with 1 being the furthest upstream hole.
CountTypeNew	Number	1=First Count (the sum of these counts are used to estimate abundance) 2=Within Reader Variability 3=Between Reader Variability
Crew	Text	First and Last name of person who counted
HourComments	Text	Notes related to the hour counted

APPENDIX C. SCALE SAMPLING PROCEDURES

Appendix C 1-Scale and length sample procedures, Anchor Riverc1

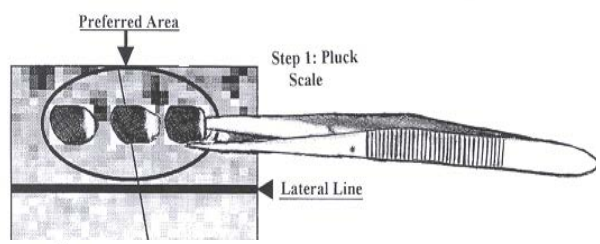


Preferred scale is located on the left side of the fish, two rows above the lateral line along a diagonal line from back (posterior) of the dorsal fin to the front (anterior) of the anal fin.

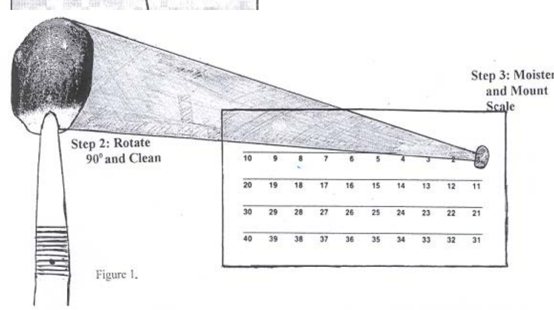


Pluck the "preferred scale" from the fish using forceps.

Pliers may be necessary to remove scales if the fish has been in freshwater for an extended period.



Remove all slime, grit and skin from scale by moistening and rubbing between thumb and forefinger. Moisten the clean scale and mount it on the gummed card directly on top of the number "1".



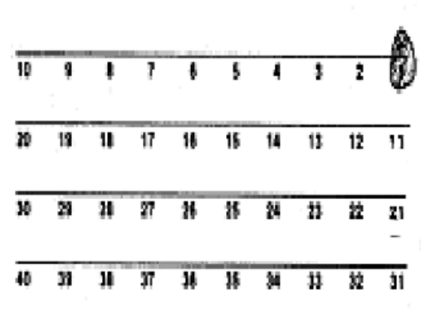
-continued-

A good scale has a well-rounded shape.

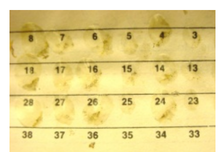
Hold scale up to light and examine for overall size, shape, regeneration, deformities, etc.

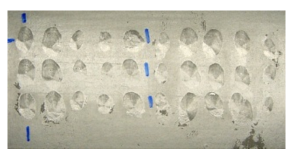
When sampling Chinook salmon take three scales per fish. Mount scale from fish # 1 over the numeral “1, 11, and 21”.

Continuing, to mount the one scale from fish #2 over the numerals “2, 12, and 22” and so on…



After the scales are mounted on the scale gum cards they are pressed onto acetate

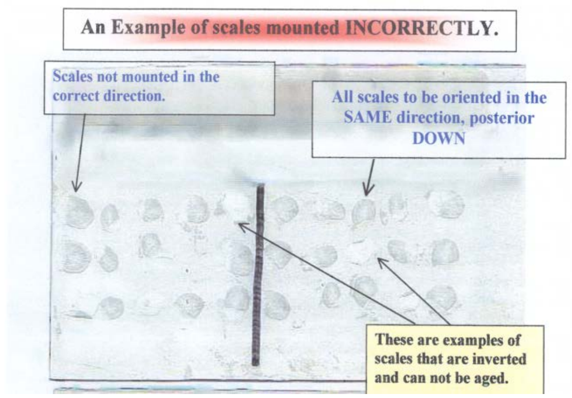




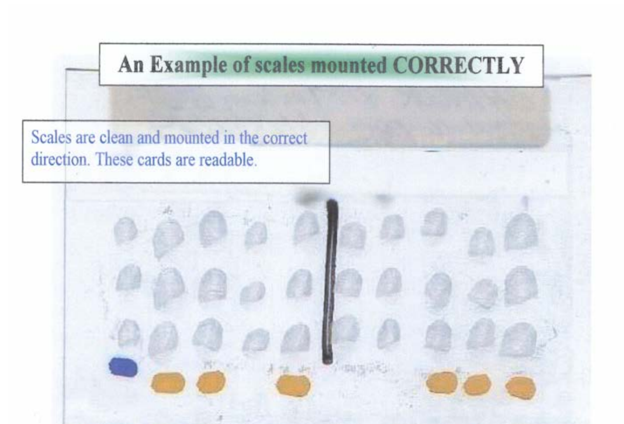
-continued-

Appendix C 1 (continued)

Incorrect scale mounting



Correct scale mounting



Appendix C 2 -Age, sex, and length sampling problems

Common problems encountered with inexperienced scale collectors are: torn edges, inadequate scale cleaning, selecting regenerated or distorted scales, inverted scale mounting, and dirty gum cards. Common data recording errors include: recording the scale number for sample, incorrect number of scale samples collected than recorded data, and more than one fish with the same collection number. The following steps should help resolve these problems:

- Experienced staff must take extra measures to ensure that less experienced staff becomes fully proficient at sampling before the first sampling event. Before the first sampling event, take one fish and slowly walk through the sampling routine with less experienced crew. This routine should specifically demonstrate how to:
- Locate the lateral line and preferred scale sampling area;
- Identify irregular scale patterns that are the result of regenerated scales;
- Remove the scales in a manner that reduces torn edges;
- Properly clean and mount scale samples;
- Identify inversely mounted scales.

Minimize the handling of gum cards and keep them as dry as possible. Wet gum cards should be dried out slowly. Excessive heat when drying may cause the scale to become unglued from the gum card. After the gum cards are dry they should be stored with wax paper between each gum card. Check the numbering between the access database and the gum card.

A final step to improve quality is to identify sampling problems promptly so that corrections can be implemented in season. To achieve this, gum cards should be sent to the Homer office as quickly and as often as possible throughout the season. Homer staff will press the scales, review and examine for sampling problems. The person actually collecting the scales needs to be identified on each gum card so feedback can be effectively directed to the source.

Appendix C 3 -Scale Interpretation training and refresher procedure

Reader Verification:

Readers will review a test set of 50 scale samples from both Chinook and coho salmon. The test set contains scale samples from 2003 through 2007 for each species from various locations. Chinook salmon scale samples will include some fish of a known age. Readers test set ages will be compared to previous age estimates and known ages. Ages that do not match will be reviewed and re-read. Once the reader ages are resolve, then the reader will begin with the collected samples from this season.

Scale Interpretation and Criteria:

To estimate scale age, at least one scale per sample must have:

- A clean focus.
- Little or no regeneration in the freshwater growth.
- Minimal tearing on the edge.
- Clearly identified annuli through winter growth periods and crossing over of rings.

If none of the scales for each sample does not contain all of these characteristics than the age will be recorded as “NR” not readable. Samples with differing scale age estimates (i.e. scale 1 = 2; scale 2 = 2; scale 3= 1) will be recorded as “NR”

A large number of scales have been collected from the projects. It is better to reject a fish from the sample size than to use questionable scales.

APPENDIX D. CODED WIRE TAG SAMPLING PROCEDURES

Appendix D 1 -Coded-wire tag procedure

USE THE CINCH STRAPS SEQUENTIALLY. Fill out a Coded Wire Tag Sampling Form. In the sampled information, write the total number of fish that were let above the lower weir that day and the total number with adipose fin clips. Store and organize all completed forms in the appropriate folder. These steps will minimize confusion during data editing.

Coded Wire Tag Sampling Form Directions:

Fields to be used on this form are:

- Page of Pages. Begin with page 1 each day. If more than one page is needed, that day, they should be numbered sequentially from the beginning of the day.
- Sample Number= 08DU2_ _ _. The spaces should be numbered sequentially 1 to n+1.
- Source. Circle "Escapement-survey" for weir and netting data, "sport" for sport harvest.
- Survey Site. Write "Anchor River".
- Sample Type. Circle "random" for heads collected during your sampling day.
- Sampler. Write your full name
- Date Sampled. Write the month and day of sampling using leading zeros.
- Sampling Information.
    - Total # fish counted = by species the number with adipose fin+ without adipose fin; Count only those fish you are sure either have or do not have an adipose fin. If you do not get a good look at the fin do not count that fish.
    - # AD-Clips seen = Total number fish where adipose fin was missing.
    - Were all checked? Circle y if all of the Chinook salmon were checked for the presence of an adipose fin.
- Water Type = Freshwater.
- Head Recovery Information.
    - Check Box= (do not check)
    - Head Number = Cinch strap number

    1. Note: cinch strap is missing from the sequence, list the number on the sampling form on which it should have appeared. The number along with the word "Void" should be written in the comment section of the sampling form.

    - Species Code= Use codes identified in Appendix B3.
    - Length = mid-eye to fork-of-tail to the nearest 5 mm
    - Clip = 1, 2, or 3. (Enter "1" if adipose fin has obviously been clipped; enter "2" if the clip is questionable; enter "3" if you did not examine the fish but only received the head).
    - Sex = "F" for female; "M" for male

Appendix D 2 -Coded-wire tag data entry form for the Anchor River

Alaska Department of Fish and Game

Coded Wire Tag Sampling Form

Rack Return and Escapement Survey

South Central, Westward and AYK Regions

Page Info for this Sample Number only! See Instructions

PAGE ____ OF PAGES ____

SAMPLE NUMBER: 1 1 D U 2

SOURCE: (circle one) rack return | escapement survey

SURVEY SITE: Anchor River

SAMPLE TYPE: random | select

SAMPLER: ____________

DATE SAMPLED: __ __ - __ __ - Y Y

SAMPLING INFORMATION

This Box to be completed for RANDOM Samples Only

SPECIES (CODE)	TOTAL # FISH CHECKED FOR AD-CLIPS	# AD-CLIPS SEEN	WERE ALL CHECKED?
(410)CHIN			y n
(411)JACK CHINOOK-ONLY			y n
(420)SOCK			y n
(430)COHO			y n
(440)PINK			y n
(450)CHUM			y n
(540)STHD			y n

AREA INFORMATION (DISTRICT - SUBDISTRICT)

			OTHER DISTRICTS
231-	245-	331-	
241-	246-	334-	
244-21	247-		

NAME of PLACE SURVEYED: (HATCHERY OR STREAM) Anchor River Weir or Netting

WATER TYPE: saltwater | freshwater

ANADROMOUS STREAM# (FRESHWATER-ONLY) 244-10-10010

HEAD RECOVERY INFORMATION

✓	HEAD NUMBER	SPECIES CODE	LENGTH (mid-eye to fork in mm)	CLIP	SEX

COMMENTS

T:\FORMS\2005VISIO\RACKCWA2005.VSD 5/12/2005 03:17

Appendix D 3 -Coded-wire tag escapement shipment form

ALASKA DEPARTMENT OF FISH AND GAME

SHIPMENT SUMMARY FORM
CODED WIRE TAG

(PLEASE INCLUDE COMPLETED FORM WITH CWT SHIPMENT)

SOURCE: COMMERCIAL PNP SPORT PERS. USE SUBSISTENCE RACK ESCAPEMENT JUVENILE
(CIRCLE ALL INCLUDED)

SURVEY SITE (S):________________ BEGINNING SAMPLE # ________________

HEADS RECOVERED FROM STATISTICAL WEEK ________ ENDING SAMPLE # ________________

DATES RECOVERED: ____ / ____ - ____ / ____ / ____
MONTH DAY MONTH DAY YEAR

1 [ ] + 2 [ ] - 3 [ ]

OF HEADS LISTED ON FORMS

OF HEADS SHIPPED DATA (SEE "A"

OF HEADS NOT (SEE "B"

= 4 [ ]

ACTUAL OF HEADS BOXED FOR

A
HEADS SHIPPED WITHOUT
(IF SAMPLING FORM LOST, GENERATE NEW

CWT HEAD NUMBER* *(SIX						DATA ALREADY SENT?	OTHER, EXPLAIN BELOW

B
HEADS NOT SHIPPED

CWT HEAD NUMBER* *(SIX						HEAD WITH PROCESSO	HEAD LOST	OTHER, EXPLAIN BELOW

COMMENTS: (USE BACK OF FORM IF

DATE SHIPPED:________________ FORM COMPLETED BY: ________________________

T:\FORMS\2005VISIO\SSSUMMARY2005.VSD 05/12/05 03:16

APPENDIX E. CREW SCHEDULE

Appendix E 1 -Schedule for the Anchor River field operation, 2012.

	Crew				
Date	Kelsey Kliene	Vacant Tech 2	Holly Dickson	Jon Kee	Sonar Support person
5/1	Sonar Prep				
5/2	Sonar Prep				
5/3	Sonar Prep				
5/4	off				
5/5	off				
5/6	Sonar Prep				
5/7	Sonar Prep				
5/8	Sonar Prep				
5/9	Sonar Prep				
5/10	Sonar Prep				
5/11	off				
5/12	off				
5/13	Sonar Install/ Operation			Sonar Install	Sonar Install
5/14	Sonar Install/ Operation			Sonar Install	Sonar Install
5/15	Sonar Operation				Tim Blackmon
5/16	Sonar Operation	1st day/ Sonar training		Sonar training	Sonar training
5/17	off	Sonar Operation			Mike Booz
5/18	off	Sonar Operation			Carol Kerkvliet
5/19	off	Sonar Operation			Carol Kerkvliet
5/20	off	Sonar Operation			Mike Booz
5/21	Sonar Operation	off			Carol Kerkvliet
5/22	Sonar Operation	off			Mike Booz
5/23	Sonar Operation	off			Marge Tillion
5/24	Sonar Operation	off			Marge Tillion
5/25	off	Sonar Operation			Mike Booz
5/26	off	Sonar Operation			Mike Booz
5/27	off	Sonar Operation			Mike Booz
5/28	off	Sonar Operation			Tim Blackmon
5/29	Sonar Operation	off			Tim Blackmon
5/30	Sonar Operation	off			Jon Kee
5/31	Sonar Operation	off			Jon Kee
6/1	Sonar Operation	off			Mike Booz
6/2	off	Sonar Operation			Mike Booz
6/3	off	Sonar Operation			Carol Kerkvliet
6/4	off	Sonar Operation			Mike Booz
6/5	off	Sonar Operation			Mike Booz
6/6	Sonar Operation	off			Tim Blackmon
6/7	Sonar Operation	off			Marge Tillion
6/8	Sonar Operation	off			Carol Kerkvliet
6/9	Sonar Operation	off			Carol Kerkvliet
6/10	off	Sonar Operation/ Weir Install	1st day/ Weir Install	Weir Install	Weir Install
6/11	off	Sonar Operation/ Weir Install	Weir Install	Weir Install	Weir Install
6/12	off	Sonar Operation/ Weir Install	Weir Install	Weir Install	Weir Install
6/13	off	weir operation			
6/14	weir operation	SLWOP			
6/15	weir operation		off	off	
6/16	weir operation		off	off	
6/17	weir operation		off		
6/18	off		weir operation		
6/19	off		weir operation		

continued-

Appendix E 1. (Continued)

	Crew				
Date	Kelsey Kliene	Vacant Tech 2	Holly Dickson	Jon Kee	Sonar Support person
6/20	off		weir operation		
6/21	off		weir operation		
6/22	weir operation		off		
6/23	weir operation		off		
6/24	weir operation		off		
6/25	weir operation		off		
6/26	off		weir operation		
6/27	off		weir operation		
6/28	off		weir operation		
6/29	off		weir operation		
6/30	weir operation		off		
7/1	weir operation		off		
7/2	weir operation		off		
7/3	weir operation		off		
7/4	off			weir operation	
7/5	off			weir operation	
7/6	off			weir operation	
7/7	off			weir operation	
7/8	weir operation			off	
7/9	weir operation			off	
7/10	weir operation			off	
7/11	weir operation			off	
7/12	off			weir operation	
7/13	off			weir operation	
7/14	off			weir operation	
7/15	off			weir operation	
7/16	weir operation			off	
7/17	weir operation			off	
7/18	weir operation			off	
7/19	weir operation			off	
7/20	off			weir operation	
7/21	off			weir operation	
7/22	off			weir operation	
7/23	off			weir operation	
7/24	weir operation			off	
7/25	weir operation			off	
7/26	weir operation			off	
7/27	weir operation			off	
7/28	off			weir operation	
7/29	off			weir operation	
7/30	off			weir operation	
7/31	off			weir operation	
8/1	weir operation			off	
8/2	weir operation			off	
8/3	weir operation			off	
8/4	off			weir operation	
8/5	weir removal			weir removal	
8/6	weir removal			weir removal	

Note: Crew schedules may be altered depending on project needs.